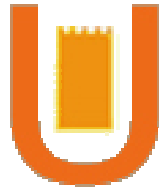


**UNIVERSITY OF ROME
"TOR VERGATA"**



**FACULTY OF ENGINEERING
Department of Mechanical Engineering**

**Ph.D. course
MATERIALS ENGINEERING**

XXI Cycle

**METAL MATRIX COMPOSITE: STRUCTURE AND
TECHNOLOGIES**

Riccardo Donnini

Tutors

**Prof. Roberto Montanari
Prof. Vincenzo Tagliaferri**

Coordinator

Prof. Roberto Montanari

A.A. 2008/2009

INDEX

Introduction	1
 Chapter 1 – Metal matrix composites	
1.1 Generality.....	2
1.2 Production technologies.....	6
1.2.1 Solid state processing.....	7
1.2.2 Liquid metal processing.....	12
1.2.3 Vapour state processing.....	16
1.2.4 Plasma/spray deposition processing.....	17
1.2.5 “In situ” production.....	20
1.3 Industrial applications.....	22
1.3.1 Aeronautics.....	22
1.3.2 Automotive.....	25
1.3.3 Electronics.....	26
1.4 Manufacturing.....	27
 Chapter 2 – The Ti6Al4V/SiC_f composite	
2.1 Introduction.....	31
2.2 State of the art.....	32
2.3 Property and production.....	33
 Chapter 3 – Experimental	
3.1 Introduction.....	40
3.2 Micro-chemical spectroscopic techniques.....	40
3.2.1 Electronic microscopy.....	41
3.2.2 X-ray Photoelectron Spectroscopy (XPS).....	42
3.2.3 Auger Electron Spectroscopy (AES).....	47
3.4 Internal friction concepts.....	49

3.5 Microchemical tests	50
3.6 Mechanical and microstructural tests.....	52

Chapter 4 – Microanalysis results

4.1 Metallographic analysis	55
4.2 SEM/EDS analysis	59
4.3 AES analysis	64
4.3.1 Zone 1	64
4.3.2 Zone 2	73
4.4 XPS analysis	76
4.4.1 XPS surface analysis.....	76
4.4.2 XPS depth profile	79
4.5 TEM observation	81
4.6 XRD observation	82
4.7 Internal friction	86
4.8 Discussion	93

Chapter 5 – Mechanical characterization

5.1 FIMEC tests	100
5.2 Tensile tests	102
5.3 Fatigue tests	104
5.4 Dynamic modulus	106
5.5 Discussion	106

Chapter 6 – Drilling of composite

6.1 The drilling operation	109
6.2 Hot drilling concepts.....	114
6.3 State of the art	115

Chapter 7 – Material and experimental

7.1 Introduction.....	118
7.2 Material.....	118
7.3 Sample properties	120

7.4	Equipment and instrumentation	121
7.5	Experimental method	125

Chapter 8 – Drilling of composite: results and discussion

8.1	Al2009/SiC _w	130
8.1.1	FIMEC tests	130
8.1.2	Cutting forces vs. feed a_z	131
8.1.3	Cutting forces vs. temperature T	132
8.1.4	Micro-hardness	137
8.1.5	Surface roughness	138
8.2	Al6061/SiC _w	140
8.2.1	FIMEC tests	140
8.2.2	Cutting forces vs. feed a_z	141
8.2.3	Cutting forces vs. temperature T	142
8.2.4	Micro-hardness	145
8.2.5	Surface roughness	146
8.3	Al6061/Al ₂ O ₃	148
Conclusion		153
References		154
Publications		158